CLAIMS

1. In a mechanical refiner having an inlet for receiving a slurry to be refined, a discharge outlet for refined slurry, a stator mounting a first refining element, and a rotor mounting a second refining element spaced from said first refining element to define a refining gap in communication with said inlet and said discharge outlet, said rotor being supported for rotary movement about an axis and relative to said stator for refining said slurry in said refining gap; the improvement comprising:

three or more actuators coupled to said stator; and

a controller in communication with said three or more actuators for independently operating said three or more actuators to adjust an axial width of said refining gap and to adjust a trim of said first refining element relative to said second refining element.

2. The improvement as recited in claim 1 wherein said mechanical refiner includes a casing defining a refining compartment enclosing said first and second refining elements, said casing mounting said three or more actuators.

3. The improvement as recited in claim 1 wherein said mechanical refiner includes a casing defining a refining compartment having an open end and an end plate closing said open end so as to enclose said first and second refining elements in said refining compartment, said end plate mounting said three or more actuators.

4. The improvement as recited in claim 1 wherein said three or more actuators are arranged symmetrically about the axis.

5. The improvement as recited in claim 1 wherein at least one of said three or more actuators includes an electric motor.

6. The improvement as recited in claim 1 wherein at least one of said three or more actuators includes a motor selected from the group consisting of an electric motor, a hydraulic motor and a pneumatic motor.

7. The improvement as recited in claim 1 wherein at least one of said three or more actuators has a ram extending substantially in parallel with the axis.

8. The improvement as recited in claim 1 wherein at least one of said three or more actuators has a drive shaft extending transversely to the axis.

9. The improvement as recited in claim 1 including a transmission connected to said stator for converting rotary power into axial extension, wherein at least one of said three or more actuators has a drive shaft coupled to said transmission for supplying rotary power to said transmission and inducing axial movement of a portion of said stator.

10. The improvement as recited in claim 1 wherein said controller is an electronic controller programmed to independently operate said three or more actuators to adjust the axial width of said refining gap and to adjust the trim of said first refining element relative to said second refining element.

11. The improvement as recited in claim 1 including at least one distance sensor mounted on said stator for generating a sensor signal related to a local axial width of said refiner gap.

12. The improvement as recited in claim 1 including at least three distance sensors mounted on said stator for generating a plurality of sensor signals related to local axial widths of said refiner gap.

13. The improvement as recited in claim 1 including at least three distance sensors mounted on said stator for generating a plurality of sensor signals related to

local axial widths of said refiner gap, wherein said controller is an electronic controller programmed to compare said plurality of sensor signals with one or more reference values, and to independently operate said three or more actuators to adjust the axial width of said refining gap and to adjust the trim of said first refining element relative to said second refining element.

14. A method for refining a slurry using a mechanical refiner having an inlet for receiving a slurry to be refined, a discharge outlet for refined slurry, a stator mounting a first refining element, and a rotor mounting a second refining element spaced from said first refining element to define a refining gap in communication with said inlet and said discharge outlet, said rotor being supported for rotary movement about an axis and relative to said stator for refining said slurry in said refining gap; said method comprising the steps of:

a) comparing local axial widths of the refining gap at three or more positions along the first refining element with one or more reference values;

b) independently moving three or more spaced portions of the stator along the axis to adjust an axial width of the refining gap and to adjust a trim of the first refining element relative to the second refining element;

c) inducing the slurry to flow through the inlet into the refining gap; and

d) rotating the rotor about the axis and relative to the stator to refine the slurry in the refining gap.

15. The method as recited in claim 14 using a mechanical refiner having three or more actuators coupled to said stator at said three or more points, wherein said step b) includes independently actuating the three or more actuators to adjust the axial width of the refining gap and to adjust the trim of the first refining element relative to the second refining element.

16. The method as recited in claim 14 using a mechanical refiner having three or more actuators coupled to said stator at said three or more points and distance sensors mounted at said three or more positions along said refining surface, wherein:

said step a) includes generating signals related to a local axial width of the refining gap at each of said three or more positions and comparing the signals with the reference values; and

said step b) includes independently actuating the three or more actuators in response to comparison of the signals with the reference values to adjust the axial width of the refining gap and to adjust the trim of the first refining element relative to the second refining element.

17. Apparatus for use in a mechanical refiner comprising:

an end plate;

a stator including a refining element, said refining element defining an axis; and

three or more actuators supported by said end plate and coupled to said stator for controlling an axial position and trim of said refining element.

18. The apparatus as recited in claim 17 wherein said refining element defines a refining surface having a bar and groove pattern.

19. The apparatus as recited in claim 17 wherein said three or more actuators are arranged symmetrically about the axis.

20. The apparatus as recited in claim 17 wherein at least one of said three or more actuators includes an electric motor.

21. The apparatus as recited in claim 17 wherein at least one of said three or more actuators includes a motor selected from the group consisting of an electric motor, a hydraulic motor and a pneumatic motor.

22. The apparatus as recited in claim 17 wherein at least one of said three or more actuators has a ram extending substantially in parallel with the axis.

23. The apparatus as recited in claim 17 wherein at least one of said three or more actuators has a drive shaft extending transversely to the axis.

24. The apparatus as recited in claim 17 including a transmission connected to said stator for converting rotary power into axial extension, wherein at least one of said three or more actuators has a drive shaft coupled to said transmission for supplying rotary power to said transmission and inducing axial movement of a portion of said stator.

25. The apparatus as recited in claim 17 wherein said controller is an electronic controller programmed to independently operate said three or more actuators to adjust the axial width of said refining gap and to adjust the trim of said first refining element.

26. The apparatus as recited in claim 17 including at least one sensor mounted on said stator.

27. The apparatus as recited in claim 17 including at least three sensors mounted on said stator for generating a plurality of sensor signals, wherein said controller is an electronic controller programmed to compare said plurality of sensor signals with one or more reference values, and to independently operate said three or more actuators to adjust the axial position and trim of said first refining element.

28. The apparatus as recited in claim 27, wherein the signals generated are one of distance, pressure and temperature conditions representing refining gap and processing conditions.

29. The improvement as recited in claim 1, wherein the actuators are further comprised of a ball nut engageable with precision threads in response to an encoded information driven motor.

30. The improvement as recited in claim 29, wherein the controller is an encoder actively adjusting the axial width of said refining gap and said trim according to changing operating conditions.

31. The improvement of claim 30, wherein the operating conditions are at least one of refiner element wear, pressure, temperature and motor revolutions.

32. A method for refining a slurry using a mechanical refiner having an inlet for receiving a slurry to be refined, a discharge outlet for refined slurry, a stator mounting a first refining element, and a rotor mounting a second refining element spaced from said first refining element to define a refining gap in communication with said inlet and said discharge outlet, said rotor being supported for rotary movement about an axis and relative to said stator for refining said slurry in said refining gap; said method comprising the steps of:

a) initializing the refining gap to zero;

b) comparing operating conditions in the mechanical refiner with one or more reference values;

c) independently moving three or more spaced portions of the stator along the axis to adjust an axial width of the refining gap and to adjust a trim of the first refining element relative to the second refining element according to operating conditions;

d) inducing the slurry to flow through the inlet into the refining gap; and

e) rotating the rotor about the axis and relative to the stator to refine the slurry in the refining gap.

33. The method recited in claim 32, wherein the operating conditions are at least one of refiner element wear, pressure, temperature, and motor revolutions.

34. The method recited in claim 32, wherein actuators comprising a ball nut engageable with precision threads move the spaced portions of the stator in response to an encoder information driven motor.

35. A method for refining a slurry using a mechanical refiner having an inlet for receiving a slurry to be refined, a discharge outlet for refined slurry, a stator mounting a first refining element, and a rotor mounting a second refining element spaced from said first refining element to define a refining gap in communication with said inlet and said discharge outlet, said rotor being supported for rotary movement about an axis and relative to said stator for refining said slurry in said refining gap; said method comprising the steps of:

a) initializing the refining gap to at least one initialized refining gap value;

b) inducing the slurry to flow through the inlet into the refining gap;

c) rotating the rotor about the axis and relative to the stator to refine the slurry in the refining gap;

d) comparing the refining gap at three or more positions with a corresponding one of the at least one initialized refining gap value;

e) independently moving three or more spaced portions of the stator along the axis to adjust the refining gap and to adjust a trim of the first refining element relative to the second refining element;

f) continuing to induce the slurry to flow through the inlet into the adjusted refining gap;

g) rotating the rotor about the axis and relative to the stator to refine the slurry in the refining gap; and

h) discharging the refined slurry through the discharge outlet.

36. The method as recited in claim 35 using a mechanical refiner having three or more actuators coupled to said stator at said three or more points, wherein said step d) includes independently sensing one of wear, distance, pressure or temperature conditions of the stator relative to the rotor for comparing the refining gap values to the initialized gap value.

37. The method as recited in claim 36, wherein the three or more actuators are independently moved to adjust the refining gap and to adjust the trim of the first refining element relative to the second refining element according to the condition sensed relative to the initialized refining gap value.

37. The method as recited in claim 35 using a mechanical refiner having three or more actuators coupled to said stator at said three or more points and sensors mounted at said three or more positions along said refining surface, wherein:

said step a) includes generating signals related to the refining gap at each of said three or more positions and comparing the signals with the reference values; and

said step b) includes independently actuating the three or more actuators in response to comparison of the signals with the reference values to adjust the axial width of the refining gap and to adjust the trim of the first refining element relative to the second refining element.